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THE ERUPTION OF MOUNT SAINT HELENS

MAY 18, 1980

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Geophysical Data Center

Boulder, Colorado 80303, USA

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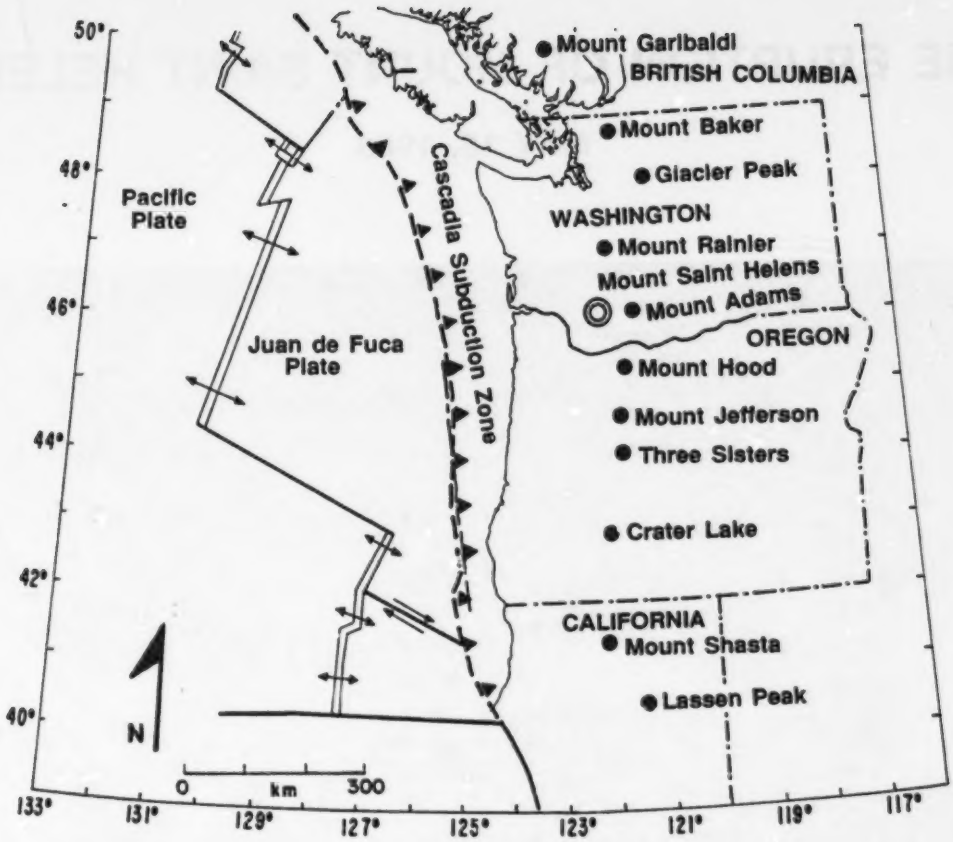
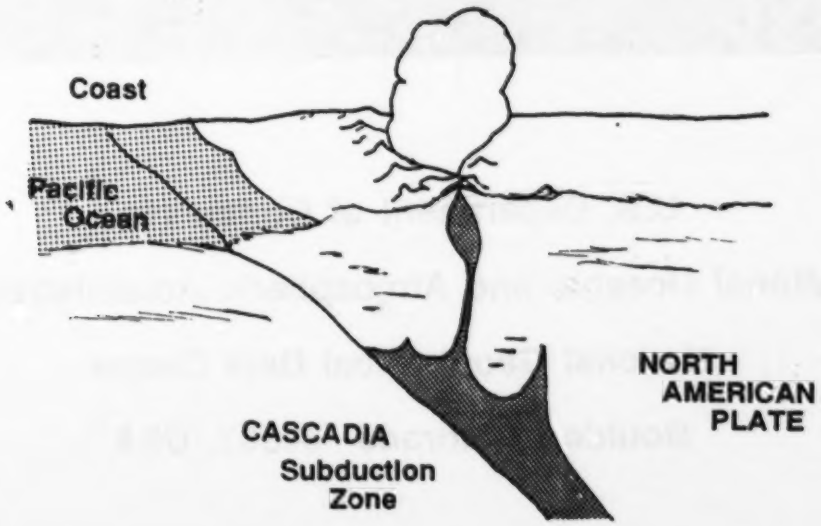


Map of the Pacific Northwest showing the plate tectonics and the location of Mount Saint Helens in relation to the other volcanic peaks in the Cascade Range. The Juan de Fuca Plate is colliding with the North American Plate in the Cascadia Subduction Zone off the coast of Oregon and Washington. Below is a diagram showing the formation of volcanic peaks along such a subduction boundary.



THE ERUPTION OF MOUNT SAINT HELENS
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The May 18, 1980, eruption of Mount Saint Helens was the most destructive in the history of the United States. Mount Saint Helens is located in southwest Washington in the Cascade Range, a mountain range dominated by periodically active volcanic peaks (see map). Geologists and volcanologists had been studying Mount Saint Helens in the 1970's and had predicted an eruption before the end of the century. The mountain had been recognized as a dormant volcano that had erupted intermittently from 1831 to 1857. The Klickitat Indians of the Pacific Northwest called Mount Saint Helens "Louwala-Clough" or smoking mountain. However, the beautiful snow-covered peak looked serene to the casual observer just days before the start of eruptive activity.

On March 20, 1980, seismographs in Washington and Oregon began recording earthquakes and a rhythmic ground shaking known as harmonic tremor (an indicator of the subsurface motion of gases or magma). A series of phreatic (steam) eruptions began on March 27. Shortly after the start of eruptive activity geologists noticed another sinister indicator of impending disaster. The north flank of the mountain had begun to swell. Aerial photographs indicated that the "bulge" increased the height of some areas of the north side of the mountain by more than 450 feet. On May 18th the bulge collapsed, triggering the eruption.

The sequence of events on May 18th began with a magnitude 5.1 earthquake. The shaking caused a massive landslide on the unstable north side--one of the largest landslides in historic times. Removal of this overburden resulted in the release of trapped gases that combined with steam from water and melted ice and snow. This massive uncorking of the volcano produced a lateral blast that downed trees up to 19 miles from the volcano. The blast hurled nearly a cubic mile of Mount Saint Helens across the landscape and into the atmosphere. The mountain lost about one-seventh of its original height, dropping from 9,700 feet to 8,400 feet. An ash cloud of new magmatic material and steam reached an altitude of more than 16 miles in ten minutes. The cloud, driven by the prevailing winds, traveled in an east-northeasterly direction and deposited ash in eleven states and reached as far east as Wisconsin.

Pyroclastic flows (gravity flows of volcanic material that has been explosively ejected from a volcanic event) periodically poured out of the crater and down the north flank into the valley below. These flows, along with hot ash and debris, began melting the snow and ice that remained on the flanks of the mountain. This debris-filled water together with ground water and rain water raised Spirit Lake 200 feet and created mudflows which moved down the Toutle River valley and the Pine Creek drainage.

The May 18th eruption resulted in scores of injuries and the loss of 60 lives. The lateral blast, debris avalanche, mudflows, and flooding caused extensive damage. All buildings and related man-made structures in the vicinity of Spirit Lake were damaged or buried. Two hundred houses were destroyed and many more were damaged in Skamania and Cowlitz Counties, leaving many homeless. Many tens of thousands of acres of forest land as well as recreational sites, trails, and four billion board feet of salable timber were destroyed or damaged. More than 185 miles of highways and roads and 15 miles of railways were destroyed or extensively damaged. Wildlife suffered heavily in the area. Many agricultural crops were destroyed downwind of the volcano. State and Federal agencies estimated that over 2.4 million cubic yards of ash - equivalent to 900,000 tons in weight were removed from highways and airports at a cost of $2.2 million. The total cost of the destruction and damage caused by Mount Saint Helens was about $1 billion.

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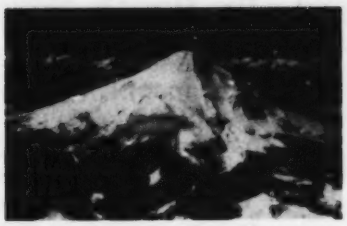
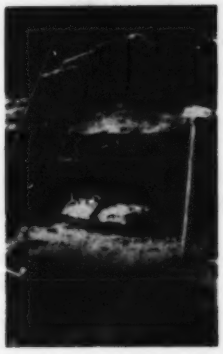
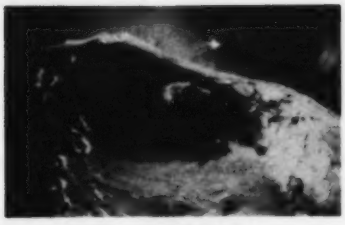


1 Mount Saint Helens as viewed from the west side (looking up the South Fork of the Toutle River Valley). In this photo taken on March 25, 1980, just two days before the first visible volcanic activity, the mountain looks completely serene. Mount Saint Helens is the youngest of the major Cascade volcanoes. Comparatively recent volcanism has not given the mountain's smooth symmetrical slopes time to develop deep erosional scars. Photograph Credit: Dept. of Natural Resources, State of Wash.

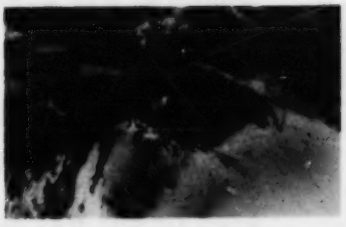


2 Buried cascade ashes between peat layers as they appeared in 1975 were a silent testimony of previous volcanism in the Cascades before the 1980 eruption of Mount Saint Helens. Volcanic activity at the Mount Saint Helens site began during the last major glaciation of the Ice Age. There have been nine periods of eruptive activity, the most recent of which ended in 1857. Two geologic reports in the decade of the 1970's identified Mount Saint Helens as the most likely volcano to reawaken in the conterminous United States. Photograph Credit: University of Colorado.



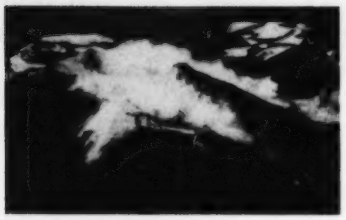
3 Initial crater and ice fractures on March 27, 1980, one day after the first phreatic (steam) eruption. The new vent was about 250 feet in diameter. The fractures crossed the crater on the north and south and ran down the west and east sides of the volcano. Photograph Credit: Dept. of Natural Resources, State of Wash.

4 Ash-darkened east slopes as they appeared on March 30. This ash was derived entirely from rock pulverized by the explosively-expanding, high-temperature steam and other gases. No new rock material was produced during this stage of the eruption. Note that the location of the ash fall indicates the direction of the prevailing wind. Mount Rainier, another volcanic peak, is visible in the background. Photograph Credit: Dept. of Natural Resources, State of Wash.



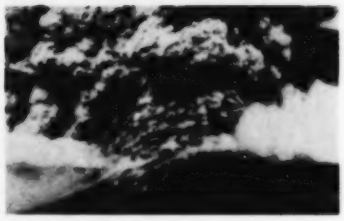
5 On March 29 a second crater appeared on the northeast side of the first crater. The new vent was 75 feet wide and 30 to 60 feet deep. This photograph was taken on March 30, 1980. The next day explosive eruptions joined the two craters. Photograph Credit: Dept. of Natural Resources, State of Wash.

6 Crater and "bulge" viewed from the east in late April. The bulge on the north-northeast flank was first detected on April 23. By the end of April the bulging area was one mile long and 0.6 mile wide. The maximum uplift had been 320 feet. Some areas on the bulge were moving at the rate of 5 feet a day. Photograph Credit: Dept. of Natural Resources, State of Wash.



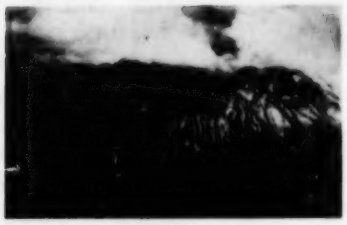
7 A typical phreatic (steam) eruption in early May. Note the increased size of the vent. Eruptive activity increased greatly about May 7th following a two week quiet period. Steam and ash eruptions reached elevations of 13,000 feet during this period. There were also steam eruptions at several sites on the north flank. Photograph Credit: National Oceanic and Atmospheric Administration, (D. Wellman).

8 The May 18th eruption, viewed from the east in late morning. The eruptive cloud rose to an altitude of more than 12 miles in 10 minutes. The swirling ash particles in the eruptive cloud generated lightning which in turn started forest fires. Other fires were ignited by the initial blasts and later pyroclastic flows. Ash can be seen falling out of the cloud. Nearly 550 million tons of ash fell over a 22,000 square mile area on May 18th. Photograph Credit: Dept. of Natural Resources, State of Wash.



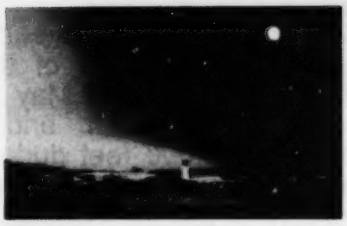
9 View of the south face from less than three miles during the height of the May 18th eruption. Note that steam as well as ash is billowing from the crater and that larger fragments are beginning to fall from the cloud. Rock fragments and pumice that were carried upward along with the ash, rained down in an area that extended 25 to 30 miles to the north and east. This photograph was taken from aboard the NOAA aircraft AEOLUS. Photograph Credit: National Oceanic and Atmospheric Administration, (D. Wellman).

10 Mount Saint Helens viewed from the north on June 4, 1980. The huge U-shaped basin formed by the landslide and the initial blast was nearly two miles long and one mile wide. The mountain was lowered 1,300 feet. Ash covered slopes, and extensive mudflows are visible in the photograph. Mudflows dumped more than 75 million cubic yards of sediment into rivers, valleys, and reservoirs. Several pyroclastic flows left about 0.05 cubic mile of deposits in this area. About 230 square miles were devastated by the eruption. Photograph Credit: Dept. of Natural Resources, State of Wash.



11 Steam venting from Mount Saint Helens as viewed from the northeast on June 19, 1980. Note huge crater on the north side of mountain and the devastation surrounding the mountain. A mud flow is visible extending to the right from the crater. Photograph Credit: Dept. of Natural Resources, State of Wash.

12 The eruption cloud as it approaches the Yakima, Washington, airport on May 18, 1980. The ash cloud moved at an average speed of about 60 miles an hour and reached the airport by 9:45 A.M., 75 minutes after the start of the eruption. The cloud became so dense that little sunlight penetrated it. Photograph Credit: National Oceanic and Atmospheric Administration, (D. Wellman).

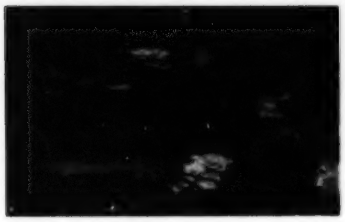


13 The ash fall at Sand Point, Idaho, more than 300 miles northeast of Mount Saint Helens. At the height of the ash fall even at this distance there was not enough daylight to properly expose film. The car has been covered to protect it from the abrasive ash. Ash continued to fall several days after the eruption had subsided. It damaged or destroyed many agricultural crops downwind from the eruption. However, in the long run the ash provided beneficial nutrients to the soils. Photograph Credit: NOAA/National Geophysical Data Center, (D. Schoolcraft).

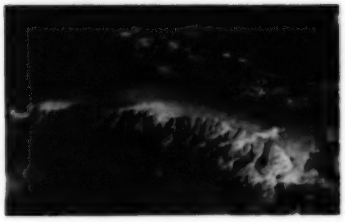
14 Uprooted trees in the ash-covered Green River valley. A small debris flow is visible on the left. Trees amounting to more than 4 billion board feet of salable timber were damaged or destroyed by the near-supersonic lateral blast of rock, ash, and hot gases. The blast devastated an area of about 230 square miles in a fan-shaped sector north of the volcano. At least 25 percent of the damaged timber was later salvaged. The photo was taken on May 24, 1980. Photograph Credit: Dept. of Natural Resources, State of Wash.

15 Abandoned vehicles in Green River valley. The northward directed lateral blast, loaded with volcanic debris, caused widespread devastation as far as 19 miles from the volcano. An area on the fringe of the devastation is shown here. In this zone referred to as the seared zone, the trees remained standing but were singed by the hot gases of the blast. A similar laterally directed explosion is thought to have occurred at Mount Saint Helens about 1,100 years ago. The photo was taken on May 24, 1980. Photograph Credit: Dept. of Natural Resources, State of Wash.

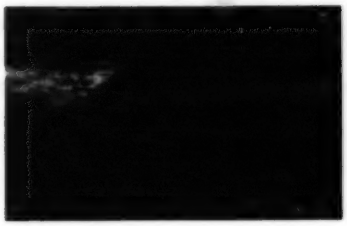
16 Surface details of the debris (mud) flow on the North Fork of the Toutle River near Coldwater Creek (see map). There is approximately 50 feet of relief between the pond and the mudflow surface. Pyroclastic flows together with hot ash from nuées ardentes (superheated masses of gas-charged ash that has been explosively expelled) melted the snow and ice on the flanks of the mountain and created these mudflows. Debris filled the North Fork valley of the Toutle River to a depth of 200 feet. This photo was taken on May 22, 1980. Photograph Credit: Dept. of Natural Resources, State of Wash.



17 This small crater west of Spirit Lake was formed by a phreatic explosion. Hot volcanic debris came in contact with water or moist ground and steam explosions resulted. Note smaller craters near large crater. The photo was taken on June 18, 1980, one month after the major eruption. Photo- graph Credit: Dept. of Natural Resources, State of Wash.

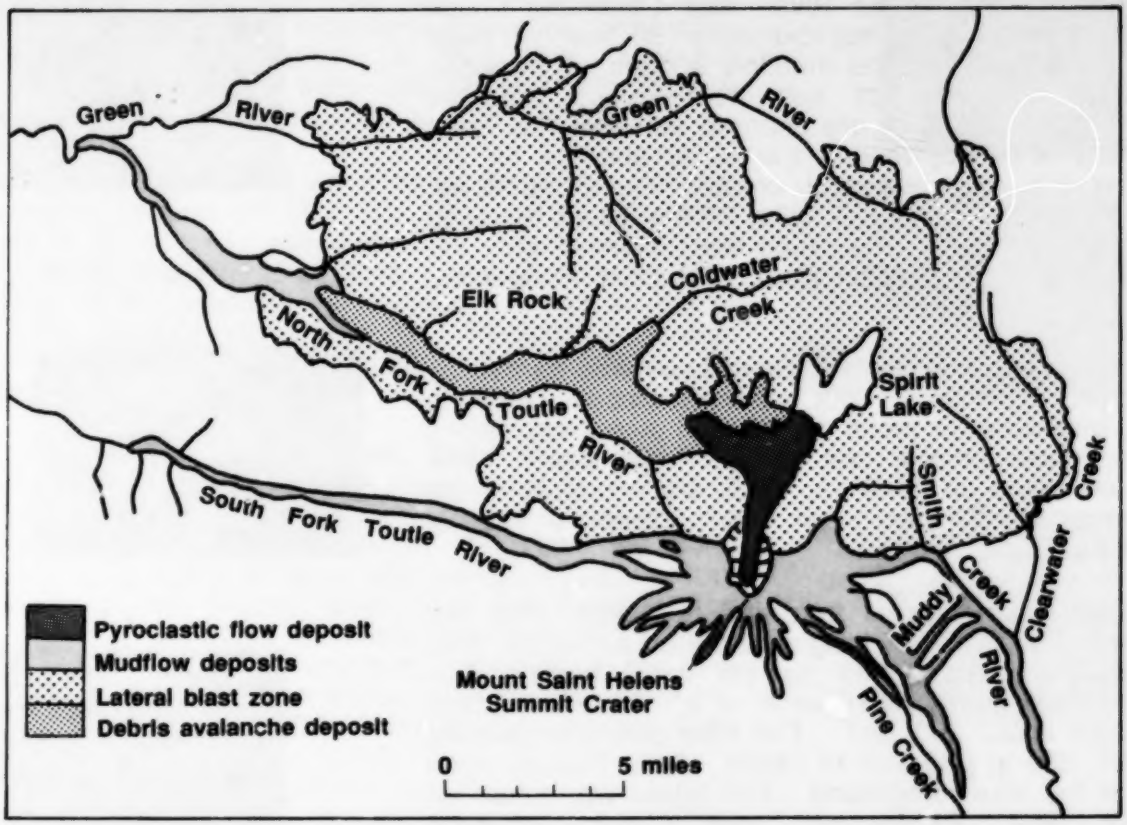


18 Spirit Lake, viewed from the northeast, after the eruption. The vacation lodges and homes in the area were destroyed or buried by the initial blast. The shoreline was moved one-quarter of a mile further south and raised about 200 feet. The lake bed was partially filled with 250 to 300 feet of debris. Note floating wood debris in the lake foreground. The photo was taken on June 19, 1980. Photograph Credit: Dept. of Natural Resources, State of Wash.



19 Snow plow removing ash from highway near Coeur d'Alene, in northwestern Idaho. More than 185 miles of highways and roads and 15 miles of railways were destroyed or extensively damaged. Many highways and roads were closed to traffic. Driving was discouraged during the ash fall because the ash was harmful to the internal combustion engines. Photograph Credit: NOAA/National Geophysical Data Center, (D. Schoolcraft).

20 The growing lava dome in the explosion crater as it appeared on May 19, 1983, three years after the main eruption. The dome is built from a composite of lava lobes extruded onto the surface during different eruption phases. Material is also added to the dome from within. As the composite dome increases in size, chances increase for collapses of its sides which could trigger pyroclastic flows and rock falls from the crater walls. Photograph Credit: University of Colorado.



Impact areas of the May 18th, 1980, eruption of Mount Saint Helens.

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